

## Session 2: Impact on Ecology

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An ecological perspective on plant diseases in south-western Australian ecosystems is fundamental to appreciating impacts and possible solutions. The inter-relationships and processes linking organisms and their environment are diverse, often complex, and ever changing. The more components there are in ecosystems, the greater the complexity in ecological relationships and processes.

It should come as no surprise, therefore, that in a region of the world with exceptional diversity in its terrestrial vascular flora and marine algae, the ecological impacts of plant diseases are profoundly diverse and subject to no simple solutions. The four papers in this session have admirably illustrated this observation.

The environmental focus of ecology leads us to question what might be special in south-western Australian ecosystems to lead to the plant epidemics we are witnessing today. Factors that deserve consideration include:

- an ancient flat landscape with soils that are predominantly acidic, highly leached and nutrient deficient, and drainage is often sluggish or uncoordinated (*diseases such as dieback thrive in acidic moist soils*);
- an exceptionally rich vascular flora, that has evolved in isolation for a long time, and with a bewildering array of adaptations to cope with nutrient deficient soils, many involving symbiotic partnerships with microorganisms such as mycorrhizal fungi (*a diverse range of vulnerable hosts for diseases*);
- a modern climatic regime in which districts having the most diverse floras are drought-prone and stressful to plant growth and recruitment (*regular environmental stresses making plants even more vulnerable to disease*);
- a profound, rapid and ongoing human transformation of the landscape following European colonisation, concentrated in farming and industrial districts where the vascular flora is richest *i.e.* the wheatbelt, Swan Coastal Plain *etc* (*human activity places major stresses on native plants through direct destruction or alteration of habitat by fragmentation, altered landscape processes, introduction of weeds and pests etc*).

As eloquently documented by Bryan Shearer, we are faced in south-western Australia with active plant diseases

of unprecedented impact and number. Our knowledge of the diseases themselves is rudimentary in most cases. Indeed, there is much more to learn about basic taxonomy and biogeography, let alone ecology, of the majority of the key players in this combination of epidemics. It is estimated, for example, that as much as a third of the 8000+ vascular plants of the south-west of Western Australia have yet to be described, and even higher proportions of the invertebrate fauna and micro-organisms (including the disease agents themselves) are similarly undocumented. Extinction undoubtedly is being played out as we gather our thoughts today.

What can be done? The concept of integrated pest management (Peter Bridgewater, Giles Hardy *et al.*) developed and applied in agriculture, provides a positive model. It requires knowledge of the disease organism, the host and pertinent environmental processes. However, agricultural ecosystems are much simpler in biodiversity than those of concern in south-western Australia, and the economic contribution of agriculture ensures that research is relatively well funded.

A similar model is that of integrated conservation (Falk 1990), but here the focus is on using the full array of *in situ* and *ex situ* approaches to ensure conservation of wild organisms in the face of rapid and potent threats. Tactically, it requires giving priority to those organisms under the greatest threat of extinction (*i.e.* critically endangered taxa). The approach emphasizes the important synergies that arise from an integration and combination of actions taken both in the wild and offsite in botanical gardens or zoos.

Where the situation is critical in the wild, as emphasized by Wills and Keighery for endangered plants, and by Keighery *et al.* for fragmented remnant vegetation infected by disease, the collection and storage of germplasm for future restoration and recovery programs is essential to avert extinction. Fortunately, recent advances in cryostorage potentially offer an economic and long-lasting approach to effective *ex situ* management of the large number of threatened taxa facing extinction in south-western Australia (Touchell & Dixon 1993; Touchell *et al.* 1992).

For the greater majority of taxa and communities under threat, the best way forward would seem to be a combination of containment of the spread of disease, integrated research on the taxonomy, biogeography and biology/ecology of the disease agents, their hosts and associates, and active restoration of communities in areas removed from infection.

Containment is clearly as much a social and political challenge as it is an operational problem. The impact of human activities on wild ecosystems in south-western Australia is pervasive. Part of an integrated approach to disease

management should embrace the best of professional skills in marketing, politics, ethics, education and economics if the public at large is to embrace a commitment to disease hygiene and containment.

Regarding research, it is heartening to see the increasing commitment of funds to the problem from organisations such as the Australian Nature Conservation Agency and Alcoa Australia. The one concern I have is that the need for integrated research is lost sight of — we need to invest our limited research funds wisely, at an appropriate level to understand the disease organisms, their hosts, associated organisms and pertinent environmental factors.

I would hope that allocation of research funds includes targeted support for traditional disciplines such as taxonomy, biogeography, and ecology, as well as modern and currently more popular molecular, genetic and cryobiological approaches, because we need knowledge in all these fields to effectively manage the problem.

The restoration and reconstruction of communities is clearly going to be required as part of the integrated ap-

proach to dealing with plant disease. This is a challenging, but potentially most rewarding, field of activity that can capture the imagination of the public at large. The extensive grass-roots support for tree planting in the wheatbelt is a tangible example. A sound knowledge of horticulture is integral to the success of such reconstruction activities, and I see a major role for botanic gardens to play in supporting and working alongside land managers to achieve conservation through restoration ecology.

Symbiosis is an extraordinarily successful strategy among the diverse organisms in ecosystems of south-western Australia. Integrated and collaborative action on our part offers the best chance many of these organisms have for the future.

#### References

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